TITLE

DOOR RESTRICTOR

FIELD OF THE INVENTION

The present invention relates to an elevator door restrictor and more particularly to a system for preventing an elevator door from being opened unless the elevator car is near a floor or landing.

BACKGROUND OF THE INVENTION

When an elevator car is caused to be stalled between floors of a building, the persons trapped in the car should remain in the stalled car until trained assistance arrives to facilitate evacuation. However, oftentimes in such situations, some of the trapped persons may attempt to force the elevator door open in an effort to evacuate. In certain instances the above situation can be extremely dangerous, such as, for example, when the stalled elevator is not at or close to a landing. In such a situation, trapped persons may attempt to jump from the elevator car or climb to a landing. As a result, the trapped persons may fall into the hoistway or elevator shaft, resulting in injury.

Such accidents may be avoided by a door restrictor system that is effective to prevent the opening of the elevator car from inside of the car if the car is at a location away from a landing at a floor of the building.

Restrictor systems of the type referred to above generally include a latching or locking member that is typically not accessible from the inside of the elevator car and must be retracted to render the elevator doors operative. These systems may include sensing means which are capable of producing a signal when the elevator car is at or close to a landing and an electrical actuator which retracts the latching or locking member in response to the produced signal.

The floor sensing means may be an electric switch mounted on the elevator car and actuated by contact with contacting members mounted in the elevator hoistway and more specifically, may be typically mounted on the elevator guide rail and located along

the path of travel of the switch. These types of switches tend to deteriorate from wear and are prone to breakage causing continual inspection and frequent replacement.

In recent years door restrictor systems have included photoelectric sensors for detecting the location of an elevator car in respect of the floor landings in a building. An infrared light emitter and appropriate detector are carried by the car and are directed towards the elevator guide rail of the wall of the hoistway. Spaced apart infrared reflecting members on the guide rail or hoistway wall are disposed to reflect infrared radiation from the emitting member when the elevator car is at or close to a landing. Similar systems have employed optical sensors and magnetic sensors to sense the floor landing and lock, or in certain instances, unlock the elevator doors by means of an associated solenoid.

These systems have been deemed unacceptable because they default to a certain position when the electrical power is off and associated back-up battery dies.

Accordingly, some manufacturers have adapted a restrictor system which defaults to a locked state and others default to an unlocked state. Each of these systems results in a state that will be wrong in some instances.

It would be desirable to produce a bi-stable locking system which can remain in either the locked or unlocked state when electrical power is terminated.

SUMMARY OF THE INVENTION

Consistent and consonant with the present invention, a bi-stable locking system which can remain in either the locked or unlocked state when electrical power is terminated, has surprisingly been discovered.

The present invention, in the preferred embodiment utilizes battery-backed electronics for sensing the presence of a building landing. Such a system will continue to maintain the mechanism in the correct state, either locked or unlocked, even if the elevator car continues to move. In a power failure, typically, the elevator car will stop moving within ten (10) seconds. After the expiration of the ten (10) second period, the elevator car should move only if an authorized person is on site to physically lift the brake or open a lowering valve. Even if a battery backup were to become completely

discharged, the mechanism will remain in the last state (either locked or unlocked) and prevent the elevator car door from being opened until an authorized person takes the appropriate step to move the car or open the car door.

The door restrictor for preventing opening of an elevator car door by a person inside the car when the car is between unlocking zones at landings along the path of travel of the elevator car comprises:

a primary source of electrical power;

a detecting member in electrical communication with the primary source of electrical power; and

an actuated locking device adapted to selectively lock and unlock the elevator car door, an actuation of the locking device controlled by the detecting member, wherein, in the event of a loss of the primary source of electrical power the locking device remains in the selected locked or unlocked position at the time of the loss of the primary source of electrical power.

BRIEF DESCRIPTION OF THE DRAWING

The above, as well as other objects, features, and advantages of the present invention will be understood from the detailed description of the preferred embodiments of the present invention with reference to the accompanying drawings, in which:

Fig. 1 is a is a schematic diagram showing a door restrictor system incorporating the features of the invention;

Fig. 2 is a flow diagram showing the normal operation of the energy detecting member of the door restrictor system illustrated in Fig. 1; and

Fig. 3 is a flow diagram showing the backup power operation of the energy detecting member of the door restrictor system illustrated in Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and particularly Fig. 1, there is shown generally at **10** a schematic diagram showing a door restrictor system incorporating the features of the invention. The door restrictor system **10** facilitates selectively locking or

unlocking doors **12** of an elevator car **14** to prevent the doors **12** from being opened unless the elevator car **14** is in an unlocking zone near a landing.

The door restrictor system **10** includes a locking device **16** which is typically connected to an actuator **18**. The locking device **16** can be any conventional locking device such as a spring loaded pin, an electrical or magnetic device, or other mechanical or electromechanical device, for example. It is understood that any conventional actuator **18** can be used such as a solenoid, for example. The actuator **18** is typically electrically operated, although it is understood that other actuator types can be used such as pneumatic, for example, without departing from the scope and spirit of the invention. In the embodiment shown, the actuator **18** is electrically connected to a primary power source **20** and a secondary power source **22**. The secondary power source **22** operates as a backup system to the primary power source **20**, and may be a battery backup system or generator backup system, for example. The primary power source is typically the electrical power supplied to the building in which the elevator is housed.

The actuator **18** is controlled by a signal received from an energy detecting member **24**. The energy detecting member **24** can be any conventional detector such as a visible light energy detector, infrared detector, or a magnetic detector, for example. The energy detecting member **24** receives and detects energy from an energy emitting member **26**. The energy emitting member **26** can be any conventional emitter such as a visible light energy emitter, an infrared emitter, or a magnetic emitter, for example. It is understood that other detecting members can be used such as a mechanical detector, which detects the presence or absence of a structural member, for example, could be used without departing from the scope and spirit of the invention. Such detecting members may or may not require an associated emitting member. In the embodiment shown, the energy detecting member **24** is mounted on the elevator car **14** and the energy emitting member **26** is mounted on a shaft wall **28** of the associated elevator hoistway. It is understood that the energy detecting member **24** can be mounted on the shaft wall **28** and the energy emitting member can be mounted on the elevator car **14** without departing from the scope and spirit of the invention. The energy detecting

member **24** and the energy emitting member **26** are electrically connected to the primary power source **20** and the secondary power source **22**.

In operation, the door restrictor system allows the opening of the elevator car doors by normal automatic operation or by occupants of the elevator car only when an energy path is established between the energy emitting member **26** and the energy detecting member **24**. During normal operation, when the elevator car **14** is at a building landing or floor, energy will be emitted by the energy emitting member **26** and will be detected by the energy detecting member **24**. Thus, a signal will be sent to the actuator **18** to cause the locking device **16** to be placed in the unlocked position, as schematically illustrated in Fig. 2. Therefore, the doors **12** of the elevator car **14** will be permitted to open, either automatically, or manually. When the elevator car **14** is not at a building landing, the energy is blocked by a blocking device **30**. The blocking device **30** can be a vane or protrusion, for example, which blocks the energy emitted by the energy emitting member **26**. It is understood that other methods of blocking the energy emitted could be used, such as interrupting power to the energy emitting member **26** to cease emission of the energy. Additionally, it is understood that the actuator **18** could cause the locking device to be placed in the unlocked position in the absence of a signal from the energy detecting member **24**, wherein the energy emitted is blocked when the elevator car **14** is at a building landing.

If the primary power source **20** is interrupted or lost, the secondary power source **22** then provides power to the actuator **18**, the energy detecting member **24**, and the energy emitting member **26**. The door restrictor system **10** operates as previously described for normal operation, and as schematically illustrated in Fig. 3. It should be noted that if the primary power source **20** is lost, the elevator car may not be operable, and thus caused to remain in the position when the primary power source **20** was lost. The door restrictor system **10** will, however, continue to operate with power from the secondary power source **22** and maintain the doors **12** of the elevator car **14** in a locked or unlocked condition as dictated by the energy detecting member **24** and the actuator **18**.

It is possible that the secondary power source **22** will be lost or interrupted. If this occurs, and the signal from the energy emitting member **24** is lost, the actuator **18** will cause or permit the locking device **16** to remain in the same position as when power from the secondary power source was lost. Thus, in the event the locking device **16** was in the locked position since the elevator car **14** was not at a building landing, the locking device **16** will remain in the locked position. Conversely, in the event the locking device **16** was in the unlocked position since the elevator car was located at a building landing, the locking device **16** will remain in the unlocked position. Therefore, as a safety device, the locking device **16** will remain in the desired position, either locked or unlocked, until manually altered by an authorized attendant. So, for example, in the event the elevator car **14** is caused to stop due to a loss of the primary power source **20** at a point not at a floor landing, the secondary power source **22** will be activated and the locking device **16** will be maintained in the locked position. Should the secondary power source be lost, the locking device **16** will maintain the present position and the doors **12** of the elevator car **14** will remain locked until manually unlocked by the authorized attendant. However, in the event the elevator car **14** is caused to stop due to a loss of the primary power source **20** at a point at a floor landing, the secondary power source **22** will be activated and the locking device **16** will be maintained in the unlocked position. Should the secondary power source be lost, the locking device **16** will maintain the present position and the doors **12** of the elevator car **14** will remain unlocked. The following summarizes the various conditions under which the door restrictor system **10** may operate:

1. Normal operation (operating under the primary power source **20**) – energy detected as illustrated in Fig. 2.

2. Loss of the primary power source **20** and operating under the secondary power source **22** – energy detected as illustrated in Fig. 3.

3. Loss of the primary power source **20** and loss of the secondary power source **22** – the locking device **16** remains in last position prior to loss of power as determined by the energy detecting member **24** and the actuator **18**

From the foregoing description, one ordinarily skilled in the art can easily ascertain the essential characteristics of this invention and, without departing from the spirit and scope thereof, can make various changes and modifications to the invention to adapt it to various usages and conditions.